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The Honorable J. Randolph Babbitt  
Administrator  
Federal Aviation Administration  
800 Independence Avenue, SW  
Washington, DC 20591

Dear Administrator Babbitt:

On behalf of the Research, Engineering and Development Advisory Committee (REDAC), I am enclosing the summary findings and recommendations from the fall meetings of the standing REDAC Subcommittees (Aircraft Safety, NAS Operations, Environment and Energy, Airports, and Human Factors).

The full committee also made the following general observations:

*Excessive Safety Standards for New Systems* - The safety standards and target levels of safety being applied to new systems, technologies, or demonstrations appear to be overly conservative. While it is important to maintain and improve the high level of safety in the system, excessive safety requirements put NextGen at risk and can actually degrade safety through increased complexity, cost, delay, and uncertainty in gaining operational approval. The responsibility for safety assessment is distributed throughout the agency and there does not appear to be a clear system level process for managing risk and arbitrating safety requirements for new systems or new procedures such as reduced separation standards. The REDAC recommends an independent review of the safety standards and processes being applied to new systems and recommendations for a balanced approach to safety.

*Growing Importance of Environmental Issues* - Environmental issues, particularly those relating to green house gas emissions, are emerging as key constraints on the air transportation system. The REDAC urges that environmental issues be given the same consideration as capacity issues in research and strategic planning as they are just as significant a risk to the future viability of the air transportation system.

*NextGen Research Requirements* - The REDAC was encouraged to see the beginning of a well defined process for generating NextGen research requirements from the Enterprise Architecture. The REDAC is concerned that the architecture may be more complex than necessary and cautions that the process could become unwieldy or intractable if not carefully managed.

*Software and Digital Systems* - The FAA has a unique need for expertise on critical software and digital systems both for its certification and acquisition responsibilities. The REDAC reiterates its concern that there has been inadequate progress in developing the core competency and technical workforce in this area. The REDAC recommends that this be given urgent priority.

*Unmanned Air Systems* - There continues to be pressure to develop a long term Con-Ops for UAS operations in the NAS for DOD and civil users. The current Certificate of Authorization processes are short term solutions and are unable to keep pace with the demand. While there has been some progress, the REDAC considers the current approach inadequate to meet the needs of government and industry.

*Weather in the Cockpit Research Program* - The recently formed Weather in the Cockpit research program was found by several REDAC subcommittees to lack a clear mission, goals or connection to NextGen requirements. The program should be focused or terminated.

We hope that these observations are useful to you and the agency. The REDAC stands ready to assist if there is any way we can help in our common objectives of improving the safety, efficiency and capability of the air transportation system.

Sincerely,

R. John Hansman  
Chair, FAA Research, Engineering and Development Advisory Committee

Enclosure

**Research, Engineering and Development Advisory Committee  
Guidance on the FY 2012 R&D Portfolio**

**Subcommittee on Human Factors**

**Finding (1)**: In the previous cycle, the REDAC Human Factors Subcommittee had expressed some concern regarding the extent to which human factors was “being adequately addressed in NextGen programs beyond the efforts of AJP 61”. On the basis of the Administrator’s response to those concerns, released on 9/22, we were quite gratified with the extent to which attention is given to these issues. We also feel confident that this attention will be enduring as NextGen progresses, given the criticality of avoiding major human factors bottlenecks that have caused substantial setbacks in some previous FAA developmental efforts (e.g., the STARS system and the AAAS system in the 1990s). The briefing given by Kathy Abbott, CSTA for flight deck Human Factors, which the subcommittee received in our September meeting provided compelling evidence for the high priority offered to human factors in some units outside of AJP61. Furthermore, we are quite gratified with the appointment of the Chief Systems Engineer for Human Factors within the NextGen I&I program, which we assume will be a permanent position with the authority to properly influence NextGen decisions as required. In order to facilitate this influence, we would also hope that this would grow into a full-time position.

**Recommendation (1a)**: Continue to place strong emphasis on human factors issues, as reflected in the Human System Integration Roadmap.

**Recommendation (1b)**: Assure in particular that human factors issues related to levels of automation in decision aiding, such as out-of-the-loop performance degradation, and human operator response to unexpected off-nominal events (e.g., automation failures) receive utmost priority and sustained funding, for both flight deck and air traffic research.

**Recommendation (1c)**: Following the excellent briefing from Flight Deck Certification, the subcommittee wishes to continue to receive briefings from other program elements within the FAA, which have direct human factors components, or involve human-in-the-loop simulation. These include, in particular, planned and completed simulations of concepts of operation within AJP66, and on all research on weather displays, and weather-related decision aids.

**Finding (2)**: The subcommittee was very impressed with the proactive efforts made by AJP61 to understand and collaborate with NASA human factors programs and harness NASA research expertise. We understand that the memorandum of agreement is about to be finalized and that efforts are already underway within the NASA Aviation Safety Program to develop research products of use for the FAA NextGen program. We observed that both flight deck and air traffic (within the FAA) have harnessed research within NASA’s Aviation Safety Program (specifically the Integrated Intelligent Flight Deck project, regarding which we were well briefed). We were however less certain of the degree of collaborative involvement of NASA’s airspace program in the FAA work.

**Recommendation (2a)**: Continue the excellent progress of collaboration with NASA’s Integrated Intelligent Flight Deck project, within the Aviation Safety Program.

**Recommendation (2b)**: Try to further engage human factors research within NASA’s Airspace Systems program in collaboration, particularly with regard to the work carried on by this group in air-ground integration and collaborative decision making.

## **Subcommittee on Airports**

**Finding (1)**: The subcommittee is pleased with the progress shown by FAA on the projects that are currently underway. The Subcommittee is likewise pleased to see that the Airport Cooperative Research Program (ACRP) program is well established, fully funded, and is achieving the goals that were hoped for when it was initiated. We see no redundancies between the two programs as they are proving to be complimentary to one another.

**Recommendation**: The subcommittee recommends that FAA reach out to other Lines of Business for consideration of the inclusion of other lines of business (such as ATO) on appropriate ACRP project technical panels.

**Finding (2)**: The Technical Center's research into bird radar systems, as part of the Wildlife Hazard and Mitigation research area, is progressing steadily.

**Recommendation**: As other detection sensors and technologies are being explored (such as: laser; optical; thermal imaging; and sound, etc.) the subcommittee recommended that coordination be pursued with MIT Lincoln Lab on radar research and development, and also that the research team initiate coordination with ATO researchers to explore the integration of avian radar research with terminal surveillance activities into a concept of operations to communicate bird hazards identified by avian radar.

**Finding (3)**: The subcommittee is pleased to see the continuing R&D activities on Aircraft Rescue and Fire Fighting (ARFF), especially the efforts on composite material fire fighting, improved RFF equipment and agents, and work regarding the operation of new large aircraft.

**Recommendation**: Continue this research with a high priority.

**Finding (4)**: The Subcommittee continues to have keen interest in the progress of research in the NextGen area.

**Recommendation**: Keep the Subcommittee informed of NextGen tasks, especially as they relate to airports and airport issues.

## **Subcommittee on Environment and Energy**

**Finding (1):** The issue of global climate change is becoming a major driver of environmental policy. In spite of its importance, there is a lack of understanding of aviation's impact on climate change, especially in the area of non-CO2 pollutants. A more robust research effort with respect to climate change is necessary to develop reasoned policy on this subject.

**Recommendation:** Current Aviation Climate Change Research Initiative (ACCRI) funding appears to be inadequate to fully study the non-CO2 impacts of aviation. The Agency should therefore ensure that future funding requests contain the resources necessary for emerging global climate change research.

**Finding (2):** Alternative aviation fuels are probably the most promising near-term tools for managing aviation's impact on the environment. The CAAFI project to develop and certify such fuels represents a significant research effort and reflects the necessary industry/government and intra-government cooperation necessary to address this issue.

**Recommendation:** Continued funding and support for the CAAFI initiative is absolutely necessary, as is the continuing partnership between industry and government and between the FAA and partner government agencies. To the extent possible, the FAA should ensure that efforts by other public entities (such as the military) are included in research efforts to avoid an unnecessary duplication of effort.

**Finding (3):** On the local level, the issue of aircraft noise remains a major priority for many citizens. In addition, the nature of noise-related complaints has somewhat shifted its focus to areas well beyond traditional areas of substantial impact.

**Recommendation:** The Office of Environment and Energy has embarked on a major new research effort to define the current noise landscape and to develop the actions needed to address any identified concerns. The Agency should endorse and encourage this effort by requesting adequate funding to continue this project.

**Finding (4):** The PARTNER Center of Excellence continues to occupy a central role in environmental research activities.

**Recommendation:** The FAA should continue to request the funding necessary to support PARTNER activities. (Note: There was some concern expressed by Subcommittee members over the fact that current versions of the pending FAA Reauthorization bill include the formation of a new Center of Excellence for Alternative Aviation Fuel, when research in this area can be accomplished through PARTNER).

## Subcommittee on Aircraft Safety

**Finding (1):** The Aircraft Safety Subcommittee noted that AVS FY 2012 Strategic Guidance requires that each Research Requirement describe the expected outcome desired by the sponsor and include an implementation plan describing how the outputs of the research will be used and implemented by the sponsoring organization in support of the desired outcome. The subcommittee noted that posing the research question is a best practice and an essential starting point for all projects.

**Recommendation:** The Subcommittee recommends that the AVS FY 2012 strategic guidance referenced in the above finding be retroactively applied across the entire AVS Research Portfolio. Adoption of this recommendation will ensure that research projects start with a desired end state in mind. The Subcommittee recommends that the research question for each project be carefully posed by the researcher in close coordination with the sponsor.

**Finding (2):** The Aircraft Safety Subcommittee found the Fire Research and Safety Program to be relevant, well managed and directly responsive to aircraft safety requirements.

**Recommendation:** The Subcommittee recommends that FAA ensure the Fire Research and Safety Program continue to be adequately staffed and funded.

**Finding (3):** The Aircraft Safety Subcommittee again noted the lack of a comprehensive and integrated Software and Digital Systems Project Plan and noted little progress in acquiring the specialized expertise required to support this critical research program.

**Recommendation:** The Subcommittee again recommends that a comprehensive and integrated program be developed and appropriate specialized expertise be acquired to spring board the FAA to a leading position in complex software and digital system safety. Inability to attract specialized talent should no longer be an acceptable excuse for lack of progress in establishing a core capability.

**Finding (4):** The Aircraft Safety Subcommittee found the Aviation Safety Information Analysis Sharing (ASIAS) project is directly responsive to the need of safety analysts within the FAA and aviation industry to understand emerging risks before they become potential safety issues and applauds the progress made in increasing the number of airline ASIAS participants. The Subcommittee notes that the ASIAS program does not address general aviation at the present time.

**Recommendation:** The Subcommittee recognizes that the attempt to automatically monitor for unknown risk based on complex data mining capabilities and seamless data sources is in fact the most difficult challenge in ASIAS and recommends that parameters be developed to indicate when the quest to accomplish this objective should be re-examined.

**Finding (5):** The Aircraft Safety Subcommittee expressed concern about the realism of wake vortex and wind shear characteristics being used for research in advanced maneuver capable flight simulators.

**Recommendation:** The Subcommittee recommends that FAA take particular care in validating wake vortex and wind shear models with real world aircraft response data.

**Finding (6):** The Aircraft Safety Subcommittee noted and applauds the progress made in achieving a limited amount of F&E funding in support of the Aerospace Medical Research Program.

**Recommendation:** The subcommittee encourages the other research laboratories to pursue similar funding options applying the aeromedical approach.

**Finding (7):** The Aircraft Safety Subcommittee noted that the Volcanic Ash Project under the Aviation Weather Research Program is not consistent with previous SAS recommendations.

**Recommendation:** The Subcommittee again recommends that research be limited to a very focused approach on how to detect and avoid a volcanic ash encounter. The Subcommittee does not believe the research related to the development of onboard technologies to detect or harden an aircraft against volcanic ash is warranted. The Subcommittee recommends that the research be limited to the development of procedures for getting tactical information to flight crews so they can effectively avoid the hazardous areas. Finally the Subcommittee believes that even this limited scope for research is relatively low priority in the broad research portfolio.

**Finding (8):** The Aircraft Safety Subcommittee expressed concern about the apparent lack of a comprehensive and integrated program plan for the NextGen Weather Technology in the Cockpit Program.

**Recommendation:** The Subcommittee recommends that the REDAC NAS Operations Subcommittee do a “deep dive” review of the Weather in the Cockpit Program at their next review meeting.

**Finding (9):** The NextGen Self Separation and Air Ground Integration Human Factors Program was briefed at a macro level. As a result the Subcommittee was unable to determine whether the program was focused on very specific and real research requirements.

**Recommendation:** The Subcommittee recommends that the REDAC Subcommittee on Human Factors do a “deep dive” review of the NextGen Self Separation and Air Ground Human Factors Program at their next review meeting.

**Finding (10):** The Aircraft Safety Subcommittee noted the positive progress made in the Unmanned Aircraft System (UAS) Research Program related to UAS regulations and standards.

**Finding (11):** The Aircraft Safety Subcommittee noted good progress by the System Safety Management Team in the development of prognostic safety assessment models intended to predict the safety impact of proposed improvements to the NAS. When completed and validated, it is essential that FAA use the tools to guide NextGen implementation.

**Finding (12):** Under the Flight Deck/Aviation Maintenance/System Integration Human Factors Program, the SAS found the 30 plus projects to be responsive to the research questions posed by the sponsor, but did not find a documented basis for the research questions. The Subcommittee also noted the lack of a priority process related to current projects in the program.

**Recommendation:** The Subcommittee recommends that FAA perform a gap analysis of the current projects against data driven requirements for increased safety.

**Finding (13):** The Aircraft Safety Subcommittee noted the good work being performed under the Maintenance and Inspection (M & I) Program and looks forward to the results being transmitted into practice.

**Finding (14):** The Aircraft Safety Subcommittee found the research conducted by FAA in cooperation with industry, under the Transport Structural Integrity Metallic R & D Program, to be relevant and a good example of self funding through industry cost sharing and engineering support complemented by the benefits from commercialization.

**Finding (15):** The Aircraft Safety Subcommittee found the Electrical Systems Program to be a practical approach to advance the knowledge of FAA in anticipation of the introduction of new technology. The Subcommittee looks forward to seeing this knowledge translated into regulatory guidance.

**Finding (16):** The Aircraft Safety Subcommittee fully supports the FAA taking advantage of the Rotorcraft research work being done by the Department of Defense related to Health Usage Monitoring System.

**Recommendation:** The Subcommittee recommends that FAA stay in lock step with the outputs of the U.S. Army rotorcraft R&D program. It is essential that FAA not fall behind.

**Finding (17):** The Aircraft Safety Subcommittee appreciated the Propulsion Research Program review, particularly the field event history that provided the motivation for the research portfolio. The data presented shows a significant reduction in the number of aircraft threatening non-contained rotor fracture events over time. It is evident that the FAA team has formed a strong partnership with industry to develop and enact effective improvements in the design, manufacture and inspection methods for engine rotors.

**Finding (18):** The Flight Controls and Mechanical Systems (FC&MS) activities presented had a clear focus with relevant objectives. Specific findings were as follows;

The Aircraft Safety Subcommittee did not review the results of the FAA Rudder Study. However, it was presented as a FY09 accomplishment with the final report due in FY09. The Subcommittee is anxious to receive copies of the final report when available and believes it will provide useful training guidance to the transport pilot community.

The General Aviation Basic Envelope Protection effort was reported as completing phase 1. The concept has the potential of protecting against GA loss of control in flight. However, the Subcommittee believes there are significant human factors issues that must be initially considered before designing a GA envelope protection system. For example, how does the system account for pilot in the loop control inputs when an automatic control device is also attempting to recover the aircraft from an upset? Under what circumstances should control be taken from the pilot? Should the automatic recovery system provide guidance cues to the pilot who then implements the recovery maneuver?

The Fly-by-Wire Research is long past due given that fly-by-wire aircraft have been certified and in operation for several years. The focus of this activity is documenting what has already been done, rather than new research. The output from this activity will enable future designs to not require certification under special conditions.

**Recommendation:** The General Aviation Envelope Protection activity must include human factor/performance issues, in particular pilot in the loop scenarios, when developing design and performance requirements for a GA Basic Envelope Protection Concept.

**Finding (19):** The Aircraft Safety Subcommittee was impressed with the research activities underway at the Centers of Excellence for: Airliner Cabin Environment; Advanced Materials and; General Aviation Research. The subcommittee believes that when complemented with FAA management competence and leadership, these cost sharing arrangements represent cost effective ways to conduct relevant research and advance the knowledge of FAA. The subcommittee found that to be the case in the programs reviewed.

**Finding (20):** The Aircraft Safety Subcommittee noted the good work being performed under the Aircraft Icing Program and looks forward to the research results being translated into regulatory guidance. The subcommittee does however question the operational benefit related to 3D icing studies.

**Recommendation:** The subcommittee recommends that FAA review the requirement to generate 3D ice shapes.

### **NAS Operations Subcommittee**

**Finding (1):** (Modeling and Simulation) The NextGen design still (see last year's findings) appears to be based largely on intuition and consensus, rather than modeling, analysis, simulation, and demonstration or testing. The FAA needs both a facile high level analysis tool (such as NASPAC and its derivatives) and a detailed modeling and simulation capability to support detailed system design trade studies to inform the NextGen design, both mid-term and far-term.

**Recommendation (1a):** Utilize the capabilities of NASA, JPDO and other government or private partners to achieve the modeling and simulation capability needed to support detailed system design studies for all phases of NextGen.

**Recommendation (1b):** The FAA should brief the plan to achieve the needed modeling and simulation capabilities to the REDAC NAS Operations Subcommittee.

**Finding (2):** (Weather Program) The subcommittee was pleased with the first version of the ATM-Weather Integration Plan. Integration is now happening, with a good example being an Integrated Departure Reroute Planning (IDRP) by CAASD / MIT LL, but it is still a significant challenge.

**Recommendation:** The FAA Plan should become an ATM-Weather Integration R&D Program with ATO, CAASD, and FAA ATM research components, and the use of modeling and simulation to understand the benefits. The subcommittee encourages the FAA to be expeditious in this development.

**Finding (3):** The Weather-in-the-Cockpit program was recently formed as RED program in ATO. Subcommittee found that it lacks a clear mission, goals, or a connection to NextGen requirements. In addition, weather information is already reaching many GA cockpits, and the connectivity to existing technology was not clear.

**Recommendation:** The FAA should review this program with lead weather researchers to establish clear objectives consistent with other activities, the FAA mission, and Next Gen objectives. An example goal might be to consider an aircraft role as airborne weather sensing node feeding NNEW.

**Finding (4):** (Concept Development ) While the subcommittee was pleased with the substance and format of the Concept Development briefing, there is still a need to better understand the overall context of the research needs and fit of the work being done into a plan for NextGen development.

**Recommendation (4a):** Provide the subcommittee future briefings on context and fit between the concept development and exploration research and the NextGen plans and Enterprise Architecture. Specific focus on the open and yet unanswered research questions in the context of connecting the research to the solution sets and OI's is needed.

**Recommendation (4b):** As was recommended by the NAS Operations Subcommittee previously, more resources should be devoted to this activity in order to understand other NextGen drivers (e.g. UAS, see below).

**Finding (5):** (Staffed NextGen Tower) The subcommittee recognizes the need for a Staffed NextGen Tower capability to improve safety in an affordable way and was pleased to learn of the FAA's plans. The operational concept and demonstration plan could benefit from further development of details. For example, it appears that undue emphasis may be placed on using only certified ASDE-X data for the surveillance source when other options (e.g., non-certified ASDE-X, ADS-B, MLAT, radar) may be better suited for particular applications.

**Recommendation:** The subcommittee recommends that the business case for SNT be strengthened with the value of additional operational efficiency and safety improvements. The subcommittee recommends that the use of other forms of surveillance should be explored (e.g., non-certified ASDE-X, ADS-B, MLAT, radar). These alternatives need to be considered in the context of how SNT might roll-out into the NAS (e.g., whether starting at smaller airports or larger airports first or timing relative to aircraft equipage).

**Finding (6):** (Environment) It was excellent for the subcommittee to be brought up to speed on the environmental tool AEDT. FAA is to be commended for developing this tool, and particularly for assisting in its use in the NASA NRA examining the impact of new vehicles in the NAS—this is a model of how the use of such tools can be accelerated and improved to provide one input into decision making and system design. Without significant changes to NASPAC, however, AEDT and NASPAC are inconsistent tools, which may hinder their use together.

**Recommendation:** The AEDT tool could be used in an iterative fashion in the FAA design and decision-making process to ensure that environmental issues are assessed early, rather than in an “ex post facto” fashion to assess the impact of previously developed routes, procedures, etc.

**Finding (7):** (UAS Integration in the NAS) A number of projects and demonstrations with various elements of DOD were presented. These evaluations and demonstrations did not appear to flow from any top-down research and development plan for UAS integration. While encouraged that the FAA is beginning to address UAS integration in the NAS, the subcommittee considers the current approach inadequate to meet the outcomes needed and timing requirements of both government and industry.

**Recommendation (7a):** Establish, in partnership with DHS and DOD, a Government internal civil-military concept of operations for UAS, as a prelude to developing public-private partnering relationship strategies for incremental implementation.

**Recommendation (7b):** Establish a partnership design process, with industry and the appropriate FAA, DOD, and DHS organizations to produce a relationship strategy. Focus the initial stages of the design process on (1) reaching a shared view of demand, and (2) establish a shared concept of operations, and (3) decide on best approaches to the partnership design, implementation, and operation.

**Finding (8):** (Demonstrations) The FAA presentation on Govt-Industry partnerships for demonstrations highlights the FAA's early efforts to increase the level of accountability and management across activities that involve the more highly visible collaborative projects. This is a very positive step towards improved management of the FAA's research portfolio. The subcommittee looks forward to receiving updates in this area.

**Recommendation:** The FAA should document and publish the specific research objectives associated with each demonstration and report regularly to the subcommittee the performance of the

demonstrations against the previously-defined objectives, including measures of positive outcomes as well as shortfalls in meeting those objectives.

**Finding (9)**: It is a clear intention of the FAA to invest in laboratory infrastructure that can be used for future collaborative efforts in a broad set of NextGen areas. Subcommittee has some concerns, however, on whether this additional infrastructure is a cost-effective use of government resources.

**Recommendation**: FAA should examine the proposed new laboratory capabilities against other capabilities to which the Agency has access, and should identify the anticipated utilization of this new investment as well as the level of sustained use of present capabilities.

## **FAA UPDATED RESPONSE TO THE SEPARATION STANDARDS WORKING GROUP REPORT**

**Finding (10)**: It was reported that the target level of safety has been increased to 10-E9. This level does not appear to be statistically achievable to the NAS Operations Subcommittee.

**Recommendation**: The target level of safety needs to be reassessed for its reasonableness and applicability. Safety levels of new systems should be compared against a baseline which is defensible based on current operations and statistical analyses.

**Finding (11)**: The NAS Operations Subcommittee ascertained that the responsibility for separation standards in the FAA was not clearly defined. While ATO apparently has the ultimate responsibility, coordination with AVS was unclear.

**Recommendation**: Given possibly different operating paradigms in NextGen, the FAA should have clear points of responsibility for the development and implementation of separation standards.